Virtual Reality Engineering Education

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Overview

Problem:

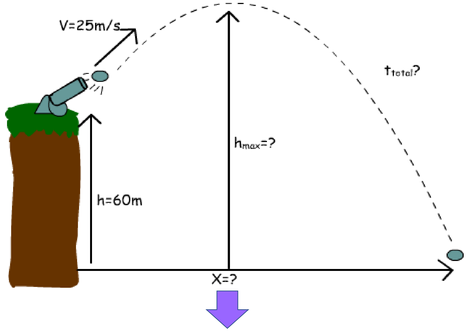
- Engineering students have trouble visualizing problems

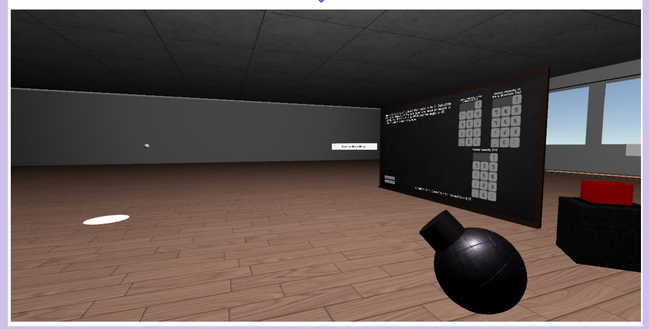
Goal:

- Develop a VR application for physics simulation
- Develop a physics library to work with Unity physics engine for better simulation
- Develop a framework for building engineering problems and demos
- Provide a modularized project for future undergraduate research

Why VR:

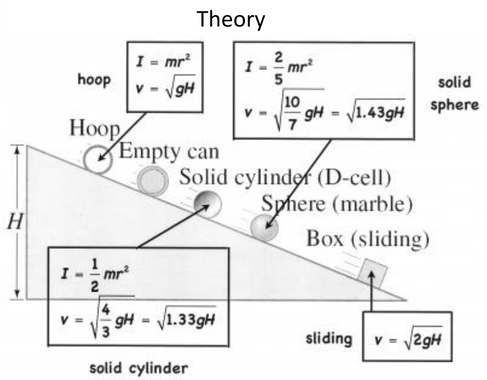
- Remove the need to build or purchase physical models for demo
- Better intractability and immersion for students



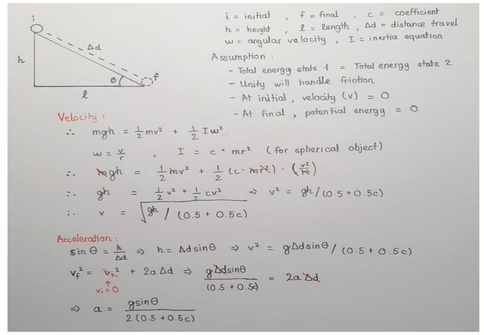


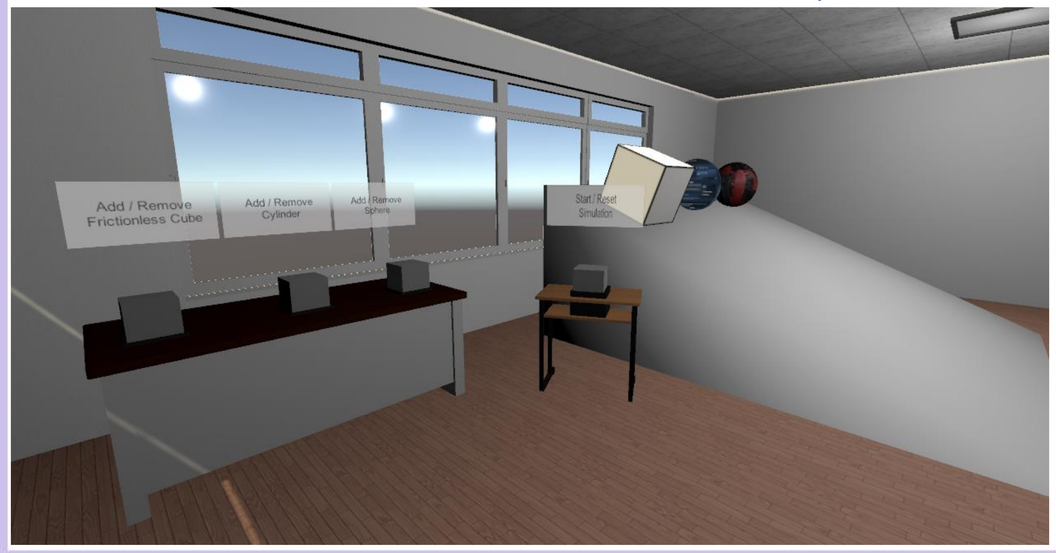
Development Process

Theory



Problem Solving





Physic Library Script

- Contains functions to calculate physics equations
- Implements in conjunction with Unity built-in physic engine for more realistic simulation
- Improve control over angular velocity and acceleration mechanism

```
private Vector3 calculateTrajectoryVelocity(Vector3 target, Vector3 origin)
{
    // Define gravity
    float gravity = Math.Abs(Physics.gravity.y);

    // Define the distance x and y
    Vector3 distance = target - origin;
    Vector3 horizontalDistance = distance;
    horizontalDistance.y = 0f;

    // Actual length of the distance
    float Dy = distance.y;
    float Dxz = horizontalDistance.magnitude;

    float height = (Dxz * Mathf.Tan(angle * Mathf.Deg2Rad)) / 4;

    Vector3 Vy = Vector3.up * Mathf.Sqrt(2 * gravity * height);
    float time = Mathf.Sqrt(2 * height / gravity) + Mathf.Sqrt(-2 * (Dy - height) / gravity);
    Vector3 Vxz = horizontalDistance / time;

    Vector3 result = Vxz + Vy;
```

Challenges

- Converting from 2D space to 3D space was hard
- Unity basic functions don't work as intended
- Unity doesn't support for translational or rotational kinetic equations
- Few documentation on Unity physics engine inner working
- Unable to meet in person
- Difficult physics concepts
- Update scripts to match the improved user input system

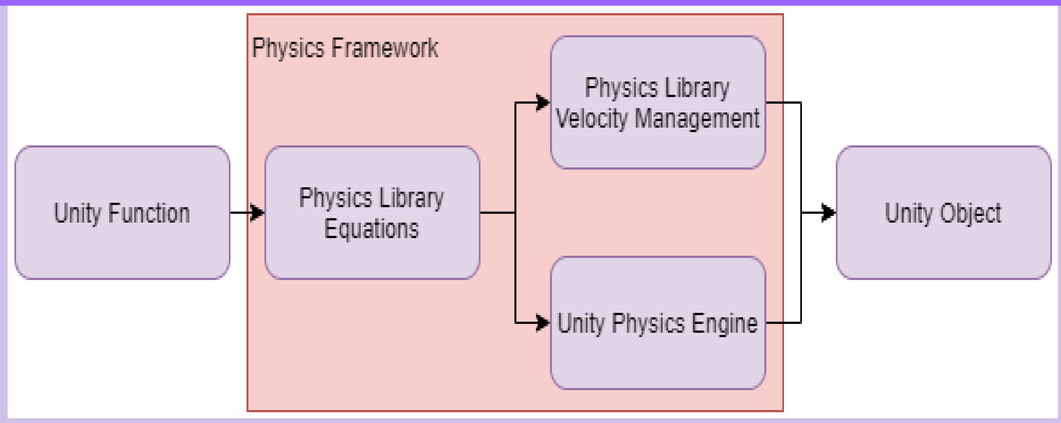
Lessons Learned

- Derive physics formulas before implementing in Unity
- Plan all functionality and features before coding
- Centralize functions to avoid confusing script referencing
- Usability should be done as soon as possible to avoid unnoticed bugs and problems
- How to convert 2D vector to 3D vector
- Static and dynamic physics concepts

Contribution

- Developed the user input keypad system
- Developed and integrated physics framework with Unity physics engine
- Developed part of the environment for the demo

Functionality Overview



Tools Used

unity, zoom

Acknowledgment

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